POSSIBILITIES OF USING STABILIZING OPERATIONS ON THE SPINE

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Annotation. *This study presents the clinical outcomes of various stabilizing surgical techniques for the treatment of spinal pathology, including cervical disc herniations, osteochondrosis, vertebral dislocations, spondylolisthesis, fractures, and malignant spinal tumors. Based on the surgical treatment of 67 patients, the authors evaluate the effectiveness of interbody fusion using cage systems and transpedicular fixation. The analysis highlights that cage-based interbody fusion ensures reliable segmental stability, particularly in cervical osteochondrosis and dislocation cases, with minimal postoperative complications and high radiological stability. Transpedicular fixation demonstrated efficacy in managing traumatic injuries and maintaining vertebral support in tumor-induced destruction. Postoperative assessments, including Cobb angle measurements and functional imaging, confirmed the maintenance of sagittal alignment and vertebral integrity over time. The findings support the integration of modern fixation systems as standalone or combined approaches to enhance spinal stability and postoperative recovery.*

Keywords*: interbody fusion, cage system, transpedicular fixation, spinal stabilization, spondylolisthesis, spinal trauma, spinal tumors, Cobb angle.*

ВОЗМОЖНОСТИ ПРИМЕНЕНИЯ СТАБИЛИЗИРУЮЩИХ ОПЕРАЦИЙ НА ПОЗВОНОЧНИКЕ

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Аннотация. *В работе представлены клинические результаты применения различных стабилизирующих хирургических методик при патологии позвоночника, включая грыжи шейных межпозвонковых дисков, остеохондроз, вывихи позвонков, спондилолистез, переломы и злокачественные опухоли позвоночника. На основании анализа хирургического лечения 67 пациентов авторами оценена эффективность межтелового спондилодеза с использованием систем «кейдж» и транспедикулярной фиксации. Показано, что межтеловой спондилодез с «кейджами» обеспечивает надёжную сегментарную стабилизацию, особенно при шейном остеохондрозе и после вправления вывихов, с минимальными послеоперационными осложнениями и высокой рентгенологической стабильностью. Транспедикулярная фиксация показала эффективность при травматических повреждениях и при восстановлении опорной функции позвонков, разрушенных опухолью. Послеоперационная оценка, включая измерение угла Кобба и функциональные рентгенограммы, подтвердила сохранение сагиттального баланса и стабильности позвоночника в отдалённом периоде. Полученные данные подтверждают целесообразность применения современных систем фиксации как в самостоятельном виде, так и в комбинированных вариантах для повышения эффективности стабилизации позвоночника и улучшения реабилитации пациентов.*

Ключевые слова*: межтеловой спондилодез, система «кейдж», транспедикулярная фиксация, стабилизация позвоночника, спондилолистез, травма позвоночника, опухоли позвоночника, угол Кобба.*

UMURTQA POG‘ONASI STABILIZATSIYALOVCHI OPERATSIYALARDAN FOYDALANISH IMKONIYATLARI

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Annotatsiya. *Mazkur ishda umurtqa pog‘onasi kasalliklarida stabilizatsiyalovchi turli xil jarrohlik usullarining klinik natijalari yoritilgan. Tadqiqot bo‘yicha bemorlarda bo‘yin disklari churrasi, osteoxondroz, umurtqa chiqishlari, spondilolistez, sinishlar va yomon sifatli o‘smalarda operatsiyalar o‘tkazilgan. 67 nafar bemor misolida “keyj” tizimi hamda transpedikulyar fiksatsiya orqali bajarilgan oraliq (interbody) spondilodez usulining samaradorligi tahlil qilindi. Tadqiqot natijalari shuni ko‘rsatdiki, ayniqsa bo‘yin osteoxondrozi va umurtqa chiqishlaridan so‘ng qo‘llanilgan “keyj” asosidagi spondilodez kuchli segmentar barqarorlikni ta’minlaydi, asoratlar soni kam va rengenologik jihatdan ishonchli natijalar kuzatiladi. Transpedikulyar fiksatsiya esa umurtqaning shikastlanishlari va o‘simtalar tufayli zararlangan umurtqa tanasining tayanch vazifasini tiklashda samarali bo‘ldi. Operatsiyadan keyingi baholashlar, jumladan Kobb burchagini o‘lchash va funksional rentgenografiyalar orqali saggital muvozanat va umurtqa barqarorligining uzoq muddatda saqlanishi tasdiqlandi. Tadqiqot natijalari stabilizatsiyalovchi zamonaviy fiksatsiya tizimlaridan yakka yoki kombinatsiyalangan ko‘rinishda foydalanish jarrohlikdan keyingi reabilitatsiyani yaxshilashga xizmat qilishini tasdiqlaydi.*

Kalit so‘zlar*: oraliq spondilodez, “keyj” tizimi, transpedikulyar fiksatsiya, umurtqa stabilizatsiyasi, spondilolistez, umurtqa travmasi, umurtqa o‘smalari, Kobb burchagi.*

Literature review. Modern requirements for a neurosurgical approach to diseases and injuries of the spine and spinal cord include: decompression of the vascular-nerve formations of the spinal canal with the elimination of all compression factors, restoration of the correct anatomical relationship of the vertebrae and restoration of reliable stability in the vertebrae. In recent years, traumatologists and neurosurgeons have proposed a huge number of options for interbody spondylodesis (using ceramics, biopolymers, metal structures, including transpedicular systems, etc.) [1, 2], however, none of them are without drawbacks. In recent years, many

reports have appeared on good results using a "cage" type system, but their effectiveness has not yet been sufficiently studied [3-5].

The aim of the study was to share the results of using different types of spondylodesis in patients with cervical disc herniations, cervical osteochondrosis, spondylolisthesis and spinal tumors.

Materials and methods of the study

The work is based on clinical observation of 67 patients aged 20 to 60 years, treated at the RSSPMCN for the period 2021-2023. Of these, 7 with dislocations of the cervical vertebrae, 10 with fractures of the cervical vertebrae, 25 patients with cervical osteochondrosis, 20 with lumbar spondylolisthesis and 5 with spinal tumors. All patients underwent a complete clinical, neurological, radiological examination and were operated on. The indication for surgical treatment was the presence of compression of the spinal cord, its roots and instability in the vertebrae.

In cases of cervical vertebrae dislocation, especially complete and complicated with rupture of the capsular-ligamentous apparatus and disk, decompression of the spinal cord and restoration of the anatomically correct relationship of the vertebrae was achieved by closed (open) reduction of the dislocation followed by removal of the intervertebral disk. Decompression-stabilization surgery was performed from the anterolateral parapharyngeal approach. In all 7 patients, the "cage" system was used as interbody spondylodesis.

In 10 patients with comminuted and compression-comminuted fractures of the cervical vertebral bodies, anterior decompression was performed by resecting the median sections of the fractured vertebral body and removing adjacent intervertebral discs. Resection of the posterior longitudinal ligament was performed only in cases where it was damaged; in other cases, they tried to preserve it.

In cases of cervical osteochondrosis complicated by intervertebral disc herniation with compression of the spinal cord or nerve roots, decompression was achieved via discectomy performed through an anterolateral parapharyngeal approach. The procedure was completed with interbody fusion using cage implants in 25 patients (Fig. 1).

In cases of thoracic vertebral body fractures, decompressive laminectomy was performed, including, when indicated, removal of the Urban wedge. Additional interventions included restoration of cerebrospinal fluid (CSF) circulation, dissection of the denticulate ligaments, and mandatory dural repair. Spinal instability was addressed by applying a bilateral transpedicular fixation system involving three adjacent vertebral bodies.

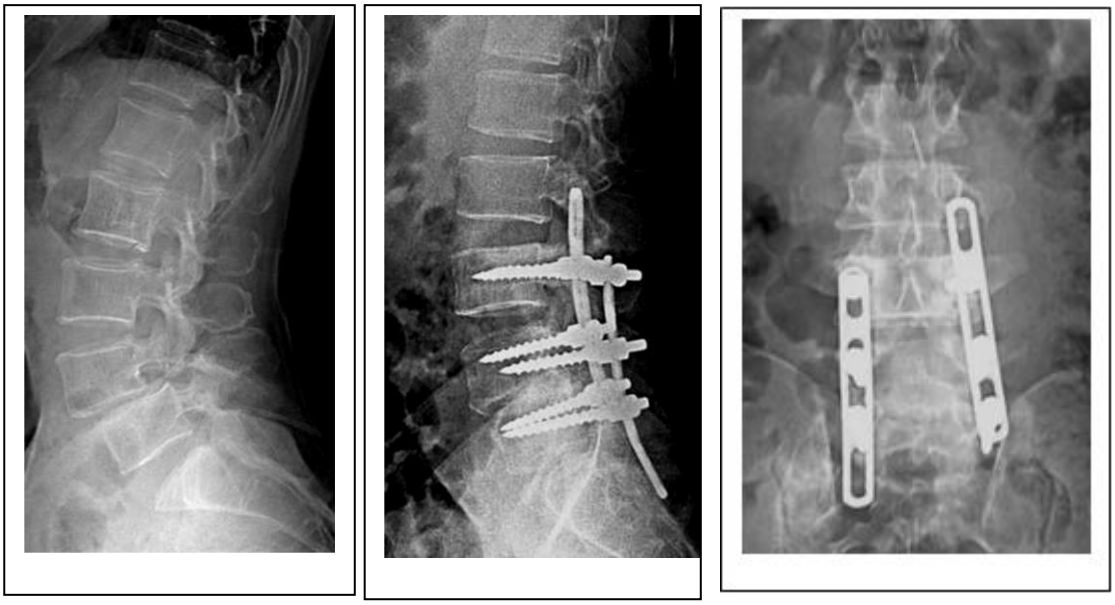


Fig. 1. *Postoperative radiograph of patient I., 47 years old, demonstrating cage placement following interbody fusion surgery.*

In cases of thoracolumbar and lumbar vertebral body fractures involving compression but preservation of the vertebral arch roots, facet joints, and laminae, spinal cord decompression was achieved through closed reduction and reclination of the fractured vertebrae. The extent of decompression achieved was assessed intraoperatively using myelography. When complete decompression of the spinal cord was confirmed, laminectomy was not required, and the procedure was completed with spinal fusion.

If reclination was insufficient, decompression remained incomplete, or there were contraindications to closed reclination, decompressive laminectomy combined with open reclination was performed. Regardless of the decompression technique used, the surgical procedure was concluded with spinal fusion. In 20 patients, fusion was achieved via the application of a transpedicular fixation system (Fig. 2).

In 5 patients with malignant spinal tumors, decompressive laminectomy, including resection of the affected vertebral body segments, was followed by interbody fusion using a transpedicular fixation system.



a) **b)** **c)**

Fig. 2. Imaging of patient R. with L4 spondylolisthesis. ***a)*** *Preoperative view: marked reduction in height of the L4–L5 intervertebral disc. L4 spondylolisthesis with one-third anterior displacement. Bilateral spondylolysis is observed.*

b, c) *Postoperative views: L4 spondylolisthesis corrected, spinal axis restored. Positioning of the L4–L5 bone graft (per Cloward technique) and interbody transpedicular fixation system is satisfactory.*

In patients with complicated lumbar spondylolisthesis, the surgical intervention included decompressive laminectomy of one or two vertebral levels, discectomy, open reduction, and interbody fusion. Interbody fusion was performed using one of three techniques: with autologous bone grafting and transpedicular fixation; with cage implantation and transpedicular fixation; or with cages alone, without additional fixation, via the laminectomy approach.

The effectiveness of the interbody fusion was evaluated dynamically at 6 and 12 months postoperatively.

Results and Discussion

Follow-up monitoring of patients who underwent atlantoaxial spinal fusion demonstrated no sagittal displacement of vertebrae or changes in the Cobb angle, indicating the reliability of the fusion technique. No cases of recurrent vertebral displacement were observed.

In surgeries utilizing cage implants, primary internal stabilization of the vertebrae was achieved intraoperatively. Postoperative functional radiographs of the operated spinal segments revealed no changes in the Cobb angle or sagittal

displacement. Several features of postoperative management in patients treated with cages were identified:

1. Additional external fixation was not required.
2. Therapeutic exercises were initiated actively from postoperative day 1–2.
3. Patients were mobilized into an upright position on postoperative days 1–2 and required minimal assistance.
4. There was no need for an additional soft tissue incision or autologous bone graft harvesting for the fusion.

Radiographic analysis demonstrated that in patients with interbody fusion using cages, there was a statistically significant absence of progressive kyphotic deformity, sagittal displacement, or loss of height of the motion segment ($P < 0.05$). In patients with cervical osteochondrosis, the Cobb angle postoperatively was $3.0 \pm 0.16°$, and remained stable at both 6 and 12 months ($3.0 \pm 0.29°$). In patients following cervical vertebral dislocation reduction, the Cobb angle measured $4.5 \pm 0.61°$, $4.0 \pm 0.45°$, and $4.8 \pm 0.83°$, respectively, across the same time points.

In patients with traumatic thoracic and lumbar vertebral injuries managed with transpedicular fixation systems, the Cobb angle decreased postoperatively but remained within a range of 5–8°. Serial analysis of spondylograms revealed the development of kyphotic deformity in both interspinous and transpedicular fusion groups; however, Cobb angles in the transpedicular fixation group were significantly lower and did not exceed 10–17°.

In cases of spondylolisthesis, significant reduction of sagittal displacement and achievement of spinal stability were observed in all three fusion techniques. Complete and sustained stability (>1 year) was achieved in patients treated with cages alone, with transpedicular systems spanning three vertebrae, and with combined cage and transpedicular fixation. In our experience, when using cages as the sole fixation method in spondylolisthesis, no progression of sagittal displacement was observed. However, we believe that in cases of unstable spondylolisthesis (Meyerding grade II–III), cage fixation should be supplemented with transpedicular stabilization systems.

In 2 patients, progression of sagittal displacement was noted during follow-up when only two vertebrae were included in the transpedicular fixation construct.

Among patients operated on for malignant spinal tumors, changes in transpedicular fixation over time were observed: kyphotic deformity progressed in 6 cases, and sagittal displacement occurred in 2 segments. However, in all cases, the fixation system acted as a stabilizing bridge, effectively unloading the structurally compromised vertebrae. This allowed early postoperative mobilization and enabled patients to maintain an active lifestyle for an extended period, with quality-of-life scores ranging from 50 to 70 on the Karnofsky Performance Scale. Furthermore, the instrumentation prevented further spinal cord compression and functional decline.

Conclusions:

1. Interbody fusion using cages provides reliable internal stabilization of vertebrae, effectively eliminating segmental instability in cases of cervical osteochondrosis and post-reduction of cervical dislocations. It can be used both as a standalone method and in combination with transpedicular fixation in lumbar spondylolisthesis.

2. Transpedicular fixation systems are effective for stabilizing thoracic and lumbar vertebral injuries, treating lumbar spondylolisthesis, and restoring vertebral support in cases of tumor-induced vertebral destruction.

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